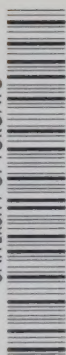


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PREVENTIVE PERIODONTICS REVIEW

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PREVENTIVE PERIODONTICS REVIEW

by

Dr. J. A. Hargreaves
concerning children

and

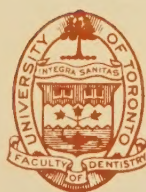
Dr. D. L. Anderson
concerning adults

with assistance from
S. B. Gilbert

RESEARCH REPORT

*issued by the
Dental Health Care
Services Research Unit*

THE FACULTY OF DENTISTRY



UNIVERSITY OF TORONTO

PREVENTIVE PERIODONTICS REVIEW

by

Dr. J. A. Hargreaves
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Prepared for

Dr. D. W. Lewis and Dr. A. M. Hunt

of the

Dental Health Care Services and Epidemiology Research Unit
Faculty of Dentistry University of Toronto
July, 1975

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1. EPIDEMIOLOGICAL RELATIONSHIPS

a) Children

In Canada, the prevalence of gingivitis was similar in boys and girls (Brown et al. 1954, McCombie and Stothard 1964, Anderson and Morrow 1970), reaching a peak at about age 14 and then decreasing in the later years of adolescence. Gingivitis was more frequent interproximally than on labial or lingual surfaces (Massler et al. 1953, Stahl and Goldman 1954, Lovdal et al. 1961, Wasserman et al. 1972). Prevalence of periodontal pockets showed a similar pattern to gingivitis. Most pockets in children resulted from enlargement of the gingiva, and tended to be transient, with loss of alveolar bone an uncommon finding.

Severity scores of periodontal disease in children in Canada indicated the presence of a gingivitis rather than a periodontitis (Freedman et al. 1965, Stamm 1971); which is similar to findings in the USA (Russell 1957, Greene 1963, Kelly and Sanchez 1972) and Britain (Sinclair and Goose 1966, Sheiham 1969). The severity of gingivitis also "peaked" at about age 14 and then decreased (Trott et al. 1967).

Boys had a greater prevalence and amount of debris (Massler et al. 1950, Mehta et al. 1955, James et al. 1960 and 1963, Green 1963, McHugh 1964, Trott et al. 1967, Sutcliffe 1968, Kelly et al. 1972, Murray 1969 and 1974, Anderson et al. 1974) and plaque (Samuelson et al. 1971, Longhurst and Berman 1973). Except for one study of deciduous dentitions by Mackler and Crawford (1973), the amount of debris or plaque and calculus was related to the severity of the gingivitis. Adolescent girls brushed their teeth more frequently than boys (Marshall-Day et al. 1955, Trott et al. 1967, McHugh et al. 1964); and in studies where the gingivitis was greater in boys, the sex difference disappeared when boys and girls of similar oral hygiene status were contrasted (Greene 1963, McHugh et al. 1964, Murray 1969 and 1974).

Gingivitis was greater where teeth were crowded (McCombie and Stothard 1964, Trott et al. 1967, Sutcliffe 1968), and where the gingiva was contacting restorations or caries (Englander and White 1964). Neither prevalence nor severity of gingivitis was influenced by fluoride in the drinking water (Brown et al. 1954, Englander and White 1964, Murray 1969 and 1974, Stamm 1971).

Although periodontitis is believed to result from a deepening extension of gingivitis (Glickman 1972, Greene 1972), the gingivitis in children frequently does not progress and develop into the periodontitis of adults (Russell 1956, Massler 1958, Wentz and Pollock 1969, Ruben et al. 1971, Glickman 1972, Baer and Benjamin 1974).

b) Adults

The prevalence of periodontal disease in adults approaches 100 per cent (Marshall-Day et al. 1955, Jamison 1960, Waerhaug 1966, Ramfjord et al. 1968, Greene 1972). Because of such high prevalence, severity was scored in most epidemiological investigations since 1960. The unanimous conclusion of these epidemiological surveys was that there is a strong association between the severity of periodontal disease and the amount of debris and calculus (Waerhaug 1966, Russell 1967, Ramfjord et al. 1968, Suomi 1971). There is convincing evidence that plaque is related to gingivitis in animals (Saxe et al. 1967, Lindhe et al. 1973, Krygier et al. 1973) and in humans with permanent dentitions (Ash and Gitlin 1964, Loe et al. 1965, Theilade et al. 1966).

The correlation between plaque or debris and periodontal disease is highest in the young age groups when gingivitis is the main form of periodontal disease; but in the older age groups when periodontitis with loss of attachment is the most common form of periodontal disease, there is higher correlation of severity of periodontal disease with the amount of calculus than with the amount of plaque or debris (Greene 1963, Lilienthal et al. 1965, Ramfjord et al. 1968). Periodontal disease scores and calculus scores were higher in India than in Atlanta (Greene 1963), in Nigeria than in U.S.A. (Enwonwu and Edozien 1970, Greene 1963, Englander et al. 1963), in Britain than in the U.S.A. (Sheiham 1973, Greene 1963), in mongoloids than in mentally retarded (Cutress 1971) and in smokers than in non-smokers (Alexander 1970, Sheiham 1973), whereas debris or plaque scores were not higher. Subgingival calculus, however, may be a result of periodontal disease rather than a cause (Mandel 1960, Schroeder 1969, Alexander 1969).

When the amounts of debris plus calculus were similar, there was no consistent relationship of periodontal disease status to sex, race, ethnic

origin, urban-rural residence, or nutritional status (Ramfjord et al. 1968). The relationship of tobacco to periodontal disease was reduced in young adults with good oral hygiene (Waerhaug 1966, 1967). Even with allowance for hygiene and age, periodontal disease seemed to be more severe in those with psychiatric disturbances, mongolism, and diabetes and less severe in those of high socioeconomic status (Russell 1967).

In all groups studied, the severity of periodontal disease increased with age (Jamison 1960, Greene 1963, Englander et al. 1963, Freedman et al. 1965, Kelly and Van Kirk 1965, Lilienthal et al. 1965, Waerhaug 1966, Russell 1967, Ramfjord et al. 1968, Sheiham 1969, Enwonwu and Edozien 1970, Sheiham and Striffler 1970, Chiranjeevi and Wade 1972). Calculus scores also increased with age, but debris scores did not (Greene 1963, Englander et al. 1963, Lilienthal et al. 1965, Sheiham 1969). The strong relationship of periodontal disease severity to age was interpreted to indicate a cumulative effect of persisting irritants rather than differences in tissue due to aging (Ramfjord et al. 1968).

2. REMOVAL OF TOOTH ACCUMULATIONS

a) Tooth Brushing

Tooth brushing has been reported to reduce the onset and prevalence of gingivitis (Berman et al. 1962, Smith and Ash 1963, Lobene 1964, Brandtzaeg and Jamison 1964, Hoover and Lefkowitz 1965); and on cessation of brushing, gingivitis recurs (Theilade et al. 1966, Loe et al. 1965, Larato et al. 1969). Toothbrushing also retards the formation of calculus (Sanders and Robinson 1962, Villa 1968).

For cleansing and plaque removal, nylon bristles were found superior to natural bristles by Maurice and Wallace (1957) and Bay et al. (1967), but not by Hine et al. (1954). Keller and Manson-Hing (1969) noted no difference. Bass (1948) believed that a soft bristle would clean the gingival sulcus, and Hanby and Pierson (1973) found a soft bristle to be more effective, but Conroy (1965) found that a medium bristle cleaned better than a soft, and Scully and Wade (1970) found hard bristles to be better than medium bristles. Bergenholtz et al. (1967) noted no difference between soft and hard bristles. Maurice and Wallace (1957) found a small number of bristles most effective for cleaning, whereas Bay et al. (1967) were of the opposite opinion. Kimmelman and Tassman (1957), Bergenholtz et al. (1967), Kardel and Olesen (1969) and Kardel et al. (1971) did not find the number of bristles to be an important factor. In a review of bristles, Bergenholtz (1972) concluded that definite information is lacking, and both O'Leary (1970) and Suomi (1971) were of the opinion that no one brush is superior for all persons.

In children, the size of the brush is important: Kimmelman and Tassman (1960) recommended a brush head approximately one inch long. Cleansing in adults was not influenced by brush size according to Kardel and Olesen (1969), Kardel et al. (1971), but Scully and Wade (1970) found short brushes to be more effective.

Manual and power brushes were reported by Kelner (1963), Quigley and Hein (1962), Smith and Blankenship (1964), Ash et al. (1964), Glass (1965), Toto (1966), Greene (1966), and McKendrick et al. (1968) to be equal in effectiveness; whereas Lefkowitz and Robinson (1962), Cross et al. (1962), Sanders and Robinson (1962), Lobene (1964), Conroy (1965), Huff

and Taylor (1965) and Manhold (1967) found power brushes to be more effective. Professional level individuals were as effective with manual brushes, but power brushes were advantageous for the physically and mentally handicapped (Kelner 1963, Vowles 1963, Oldenberg and Wells 1963, Smith and Blankenship 1964, Bergenholtz 1972).

Direct comparisons of abrasive characteristics of hand toothbrushes with automatic toothbrushes have shown no significant differences in the amount of abrasion, using either water or toothpaste (Dunkin 1974).

Effectiveness of brushing depends on how the brush is used (Manly and Brudevold 1957, Bjorn and Lindhe 1966, Glickman 1972). Although the roll technique is most often recommended (Greene 1966), no difference in plaque removal was found between the roll and vertical methods (Shick and Ash 1961), or in the reduction of inflammation between the roll and Charter's method (Curtis et al. 1957). For plaque removal, the scrub method was found (Rodda 1968), to be the most effective, then came the Fones and roll methods, with Charter's the least effective. The results of Frandsen et al. (1970) and Hansen and Gjermo (1971) indicate that the roll method is the least effective. In children, the scrub technique was the most effective (Kimmelman and Tassman 1960, McClure 1966, Rodda 1968, Sangnes et al. 1972, Sangnes 1974). Suomi (1971) and Bergenholtz (1972) felt that definite information is still not available. Thoroughness was thought to be more important than technique (Greene 1966, Glickman 1972).

Debris, calculus and periodontal disease severity scores were less in those that brushed twice a day than in those brushing once or less each day (Stanmeyer 1957, Greene and Vermillion 1960, Brandtzaeg and Jamison 1964, Horton et al. 1969, Suomi 1969, Dale 1969, Clark et al. 1969, Sheiham 1970, Kristoffersen 1970, McKendrick et al. 1970). Brushing three times was not better than twice (Stanmeyer 1957, Greene and Vermillion 1960, Clark et al. 1969). Ariaudo (1971) thought 25 minutes of oral hygiene procedures were necessary each day, whereas Arnim (1971) said 3 to 10 days would be often enough if the decision was based on evidence from disclosing dyes for supra-gingival plaque, and from microscopic examination of crevicular contents. Greene (1971) thought once a day was sufficient, whereas Loe said once every second day was enough to prevent marginal gingivitis (Lang et al. 1973). Once every three days was not as effective as once every day (Kelner et al. 1973).

b) Dentifrices

For brushing to be effective a dentifrice is required (Aleece and Forscher 1954, Manly and Brudevold 1957, Dudding et al. 1960), but Backman (1972) did not confirm this. Nylon or natural bristles without dentifrice did not abrade tooth surfaces (Skinner and Takata 1951, Manly and Brudevold 1957, Bjorn et al. 1966). Dentifrices can be abrasive (A.D.A. Council on Therapeutics 1970) with some methods of brushing (Manly et al. 1965, McConnell et al. 1967) even with soft bristle brushes (Harrington and Terry 1964). No gingival differences were found whether the ends of the bristles were round or cut (Robinson and Kitchin 1948); but gingivitis was the least with a multitufted nylon brush (Hiniker and Forscher 1954).

Dentifrice contents other than abrasives which could effect oral health are - surface active agents which cause the frothing action of some pastes, e.g. sodium lauryl sulphate; humectants which retain moisture when the paste is exposed to air and prevent the paste from hardening , e.g. glycerine and propylene glycol; binders which are hydrophilic and stabilise the tooth paste against separation of the solid or liquid phases - natural gums are commonly used; flavours such as peppermint and wintergreen together with soluble saccharin, and other active agents such as stannous fluoride.

c) Proximal Cleaners

Regular toothbrushes are inadequate in removing plaque from the interdental areas (Smith 1940, Hirschfeld 1945, Parfitt 1963, Manson and Forrest 1963, Dowers et al. 1967, Keller and Manson-Hing 1969, Hendon et al. 1969, Glickman 1972, Loe 1973, Bergenholtz et al. 1974). Various materials have been advocated to clean these areas, including small brushes (Bossy 1965, Gjermo and Flotra 1970); silk and nylon floss (Bass 1948, Keller and Manson-Hing 1969, Gjermo and Flotra 1970, Hill et al. 1973, Vogel et al. 1974); wool and gauze (Christensen 1946, Parfitt 1963, Smith et al. 1963); wooden picks (Keller and Manson-Hing 1969, Gjermo and Flotra 1970, Vogel et al. 1974, Bergenholtz et al. 1974), and picks made of rubber, plastic or metal (Rozeik 1956, Klein 1957, Garfin 1964, Glickman et al. 1964).

Floss, when properly used, cleans well (Bass 1948, O'Leary 1970), whether waxed or unwaxed (Keller and Manson-Hing 1969, Gjermo and Flotra 1970, Hill et al. 1973). Toothpicks require less time to learn to use

(O'Leary 1970), and less time to use (O'Leary 1970, Gjermo and Flotra 1970); but are not as effective on the lingual surfaces (Keller and Manson-Hing 1969), and may be contra-indicated where the gingival papillae are firm and fill the interproximal spaces (Gjermo and Flotra 1970, Suomi 1971). Improper use of floss can damage both teeth (Everett and Kunkel 1953, Leggett and Peterson 1958) and periodontium (Leggett and Peterson 1958, Bryn 1973).

The age when young children can adequately start flossing and complete the procedure satisfactorily is controversial and further information is needed in this area. Sangnes (1974) in a recent study concluded that even toothbrushing should be performed by the parents of children who are six years of age or younger.

d) Irrigation Devices

Water irrigating devices do not adequately remove plaque (Derbyshire 1964, Emslie 1964, Wilderman 1966, Summer 1966, Arnim 1967, Peterson and Shiller 1968, Toto et al. 1969, Lobene 1969, Fine and Baumhammers 1970, Elliott et al. 1972, Covin et al. 1973), but in spite of this, gingivitis was reduced (Krajewski et al. 1964, Dunkin 1965, Crumley and Summer 1965, York and Dunkin 1967, Arnim 1968, Hoover et al. 1968, Lobene 1969, Cantor and Stahl 1969, Lainson et al. 1970, Hoover et al. 1971). Covin et al. (1973), however, found an increase in gingivitis. The rate of calculus formation was also reported to have been reduced (Lobene 1969, Lobene and Soparkar 1970, Lainson et al. 1970). Irrigators may be useful as adjuncts to toothbrushing (Krajewski et al. 1964, Hoover et al. 1968, Gupta et al. 1973).

e) Disclosing Stains

Disclosing stains may be used to locate plaque and pellicle which otherwise are difficult to detect (Arnim 1963, Lang et al. 1972, Block et al. 1972). Bismark brown, and FDC red No. 3 (erythrosin) are useful when learning how to remove plaque, but stain mucosa and lips (O'Leary & Nabers 1973). DC yellow 8 fluorescein is more esthetically acceptable for subsequent assessment of the effectiveness of plaque removal (Lang 1972).

There have been no controlled studies to evaluate the effectiveness of the use of disclosing agents in improving oral hygiene (Suomi 1971).

The need for a controlled study on the motivation of plaque control in children using disclosing agents and other procedures, is recommended.

f) Implementation

Most plaque control programs have been designed for individual patients (Ferris and Winslow 1970, Pipe 1971, Ariaudo 1971, Anderson 1972, Glickman 1972, O'Leary and Nabers 1973, O'Neill 1973, Stewart 1973, Parr 1973, Block 1973). Participating group instruction was found to be advantageous in establishing plaque control in families (Anderson 1972) and in members of the armed forces (Elliott et al. 1972).

Usually, the attempt to motivate patients to perform better plaque control encompasses a stimulating talk and some information mixed with admonitions which is anticipated will increase the patient's attention and change established attitudes. This process is persuasion and not motivation; and the effectiveness of persuasion is influenced by the attitudes and values which the patient already has. To ignore what the patient thinks, is to guarantee an ineffectual persuasive approach to developing a plaque control program (Chambers 1974).

Many plaque control programs now stress the effective utilization of educational and motivational theory. Education encompasses instructors, learning theory, the material to be learned, and practice-recall. A trained teenage instructor has the best results with teenagers; a mother instructs most successfully other mothers, particularly where the mother must administer the procedures to her children; those who have experienced periodontal disease and its treatment can be effective instructors to periodontally involved patients; and the older children may be the most effective instructors for the younger members of their family (Anderson 1972).

The effectiveness of plaque control programs is dependent upon: the image of the dental office as to whether it is "healing" or "preventing" (Anderson 1972, Barkley 1972);

the amount of time allotted to teaching prevention to patients, and whether it is a program tacked on to an unchanged practice and foisted on

and assistant, or whether it is given high priority and is well planned (Barkley 1972);

the duration and comprehensiveness of the training program for the instructors (Mittleman 1970, Less 1972), and the provision of a forum for all the staff to discuss the success and failure of a patient's treatment and acquisition of hygiene skills (Mittleman 1970);

the belief of the dentist and instructors in the techniques and benefits of prevention (Mittleman 1970, Less 1972), and the value they place on their own oral hygiene and its maintenance;

the ability of the instructors to successfully complete the program to be taught (Less 1972, Block 1973) and to recognize and evaluate the response of the tissues to the procedures administered (Less 1972);

the design of the program to involve the patient and to engender in him a personal responsibility for developing and maintaining hygiene, and to acquaint him with the objectives of both the overall treatment and each procedure taught (Ferris and Winslow 1970, Pipe 1972). For example, he should be aware that the cessation of sulcular bleeding after a period of five to six days means he has attained a level of oral health (Barkley 1972, Less 1972);

the development of an honest relationship with the patient that is based on high trust and low fear (Ferris and Winslow 1970, Mittleman 1970, Less 1972, Niver and Antelyes 1973), and belief that the patient will continue with the program for an extended period (Barkley 1972);

the obliteration of popular misconceptions, such as effective hygiene must hurt a little (Pipe 1972), or "good hard brushing" can compensate for previous neglect;

the treatment of subgingival calculus, overhangs, deep pockets, and other problems to facilitate and ensure accessibility of the patient to all the tooth surfaces (Johnson 1973).

The use of negative or anxiety arousing statements which threaten the patient are not effective in producing a change in behaviour that will persist long enough to become a habit (Pipe 1972), and may result in a patient "turning off" and not listening (Mittleman 1970, Pipe 1972), or becoming

angry and rejecting the communication (Pipe 1972) and avoiding further contact with a similar situation. Anxiety arousing information should be accompanied by reassurances if it is necessary to use it, but the positive should be conveyed first and then followed by the negative (Pipe 1972). A prerequisite of effective teaching is the realization that in learning a new behaviour a patient may have to unlearn past competing behaviours. The patient may have learned not to practice, or at least to ignore oral hygiene (Ferris and Winslow 1970). How well a person learns new materials is dependent upon what he already knows (Klausmeier and Ripple 1974).

According to learning theory, there are four characteristics of good instruction: first, a small step size to insure that the patient does not get out of his depth with the information imparted (Ferris and Winslow 1970, Pipe 1971, O'Neill 1973, Block 1973, Parr 1973, Stewart 1973); secondly, active participation by the learner entails the learner doing something with each new step or piece of information learned while using his own mouth as a classroom (Ferris and Winslow 1970, Anderson 1972, Block 1973, Stewart 1973); thirdly, immediate feedback means that each time he participates he learns simultaneously how well he has performed (Ferris and Winslow 1970, Pipe 1971, Block 1973). In this respect, disclosing stains have been useful (Ferris and Winslow 1970, Pipe 1971, Douglas and Stacey 1972, Anderson 1972, Less 1972, Block 1973, Stewart 1973); and fourthly, self-pacing allows the patient to learn at his own rate and adjust the rate of instruction to the rate of learning (Ferris and Winslow 1970, Pipe 1971).

Instruction requires several visits in which the material to be learned is presented, the patient participates, and further instruction is continued for problem sites (Glickman 1972, O'Leary and Nabers 1973). Details, concerning the evidence which is available on the material to be learned, have been presented earlier in this section of the review.

A variety of educational adjuncts have been tried. Visual aids were more effective than printed material, and audiovisual aids were the best (Less 1972), especially when used in combination with study models (Van de Voorde 1972). Although helpful, these adjuncts should not be substituted for individual instruction (Glickman 1972, Less 1972).

A review of the literature indicates that educational efforts continue to be conducted on a one-shot basis with little emphasis on a first attempt evaluation (Douglass and Stacey 1972). The popular belief in the uniformly rational nature of people has facilitated widespread use of auxiliaries and audio-visual packages which present a single treatment and attempt to make everyone susceptible to it, but standardized techniques when prescribed routinely for all patients will result in a wasted effort for all but the few who are susceptible to this method (Chambers 1974).

The provision of information only is conducive to half-remembered fragments and short-lived reluctant compliance (Chambers 1974). The fact that a skill has been performed once does not mean that it has been learned (Pipe 1971). It is the practice or exercise of partially developed initial skills that leads to their fuller development. The effect of practice is to increase the stability and clarity of the information learned (Klausmeier and Ripple 1971). To enable the patient to practice, the dentist should provide the appropriate cleaning aids, a light source and a mirror for oral examination, and a supply of disclosing tablets (Ferris and Winslow 1970, Pipe 1972). The interval between appointments and the number depends upon the nature of the patient's problem, his motivation, the quality of instruction, and the rate of development of motor skills and tissue responses (Less 1972). For many people, the level of efficiency achieved depends upon their prior performance (Lightner et al. 1971, Knowles 1973).

A sequence of recalls is considered necessary if a habit is to be formed. Intervals of one week, then increasing numbers of months are tried to determine how long the patient can remain free of calculus, stain and bleeding (Barkley 1972). At the three to six month interval only 10 per cent of patients were using the brushes and aids recommended. A small printed form, listing the proper aids and where they can be purchased, helps correct this tendency (Anderson 1972). Many patients take two to three years before establishing a daily plaque control program (Barkley 1972); but in one follow-up of patients, only 10 to 20 per cent practiced good oral hygiene on a daily basis (Latimer 1971). Thus, the effects of programs may only be temporary (Williford et al. 1967, Suomi 1971, Chambers and Allen 1973).

Studies have shown that dental knowledge is not usually translated into action or health behavior (Oliver 1973, Chambers 1974). Without motivation, dental education programs fail (Pipe 1972, O'Neill 1973).

The problem of effectively motivating patients to persist with adequate plaque removal by mechanical means requires the application of psychology (Derbyshire 1970, 1973). There are five ascending levels of human need: 1. physiological, 2. security, 3. social, 4. esteem, 5. self-realization (Pipe 1972, Chambers 1974). A satisfied need does not motivate; when a problem disappears the need loses its strength, and a new need must be felt or established (Pipe 1972, Parr 1973, Niver and Antelyes 1973). Security level of needs are not likely to motivate in our society, but social and esteem levels are major needs for most people (Pipe 1972, Block 1973). Higher levels of needs are not felt until lower levels are satisfied (Pipe 1972). The identification of a patient's motivational needs entails looking at his perception of the problem and his priorities with the intention of showing him the long-term benefits that will be important to him personally.

The patient needs to understand what periodontal disease is, what its effects are, that he is susceptible to it, and what he can do to protect himself (Derbyshire 1970). Motivation to attain oral cleanliness is hampered by lack of social pressure for plaque-free mouths, lack of pain in periodontal disease, pleasures of eating, and by the inefficient methods which are available and which require excessive time; combined with the difficult physical features of both plaque and the oral cavity (Derbyshire 1970).

Preventive dentistry cannot be classified as one of the generally shared human needs. Although one must appeal to one or more of these intrinsic needs to motivate a patient, this has not been the direction taken in plaque control programs. There has been a general acceptance that health behavior is a collection of individual isolated actions which are controlled by the individual. However, others believe that health behavior is a complex system of knowledge, values, psychomotor skills and habits which are not controlled by the patient.

People who visit physicians regularly, and who voluntarily seek radiographs and screening for cancer, more frequently make preventive dental visits (Chambers 1974). The preventive dental behaviour of mothers strongly correlates with that of their teenaged children (Chambers 1974, Anderson et al. 1974). The likelihood of frequent preventive visits showed the strongest association with a history of past visits; and the best plaque control was achieved by those who were the best prior to instruction (Lightner et al. 1971, Knowles 1973). Utilization largely is independent of a person's ability to pay, and is more closely associated with the habit of previous utilization as has been revealed in studies of prepaid dental care (Chambers 1974). Desirable dental attitudes and sound oral hygiene behaviour appear to be related to a general health habit which is an element in a patient's lifestyle, and includes socioeconomic status and educational level; and are not related to short-term chairside education by dentists (Chambers and Allen 1973). Heifetz and Suomi (1973) concluded that as long as behavioural scientists are unable to determine a well-developed technology which induces behavioural change, programs of preventive dentistry which attempt to alter the individual's personal habits and lifestyle appear to have a limited chance of succeeding.

g) Partial Removal

Although it is possible for some trained individuals to completely remove plaque (Loe 1971), this may not be necessary in order to have clinically healthy gingiva (O'Leary 1970). What level of plaque is acceptable is not known, but O'Leary (1970) believes it varies from person to person, and from time to time.

Plaque scores could be reduced and maintained at a lower plateau level which was dependent on the initial plaque level. Efforts to further reduce the plaque scores by routine oral hygiene instruction were ineffective (Lightner et al. 1971, Knowles 1973). Those with the best initial state of oral hygiene had the best results from treatment (Lovdal et al. 1961, Knowles 1973).

h) Evaluation

Evaluation of an oral hygiene regimen is probably more meaningfully evaluated by assessment of the gingivitis level than by the amount of plaque present (Elliott et al. 1972).

i) Clinical Trials

Clinical trials were established to investigate the relationship of debris and calculus to periodontal disease severity which was determined by the epidemiological surveys.

Animal investigations conducted on Beagle dogs indicated that regular tooth brushing and scaling did prevent the gingivitis and destructive periodontal disease that developed in control dogs (Saxe et al. 1967, Lindhe et al. 1973).

Human clinical trials have been conducted in Oslo (Lovdal et al. 1961) and more recently in the United States (Lightner et al. 1971, Suomi et al. 1971, Elliott et al. 1972). In all the human and animal studies both plaque and calculus were removed, and by mechanical methods. Because of removal of both plaque and calculus, it is impossible to differentiate between the effects of removal of either one alone.

In the Oslo factory workers, toothbrushing, toothpicks, and scaling over a five year period reduced the severity of gingivitis. Reduction was greatest in those who originally had the cleanest mouths (Lovdal et al. 1961).

In U.S. Air Force Cadets, scaling and tooth brush instruction over four years reduced plaque and gingivitis levels, but periodontal scores increased along with some loss of periodontal attachment (Lightner et al. 1971). Those receiving scaling without instruction in tooth brushing had slightly more plaque and gingivitis.

Telephone workers in California who received extensive instruction in mechanical plaque removal and scaling approximately four times per year for three years did not have the increased levels of debris that were found in controls, (Suomi et al. 1971). Calculus and gingivitis increased, and loss of attachment occurred in both groups, but to greater degree in the controls. Loss of attachment in both groups was slight, and the difference between the treated and control groups was not significant. A follow-up examination 32 months later indicated that gingivitis and loss of attachment had not

increased in either the treated or control groups (Suomi et al. 1971).

At the end of one year in the U.S. Naval Academy, the midshipmen who had received a power brush, single tuft brush and dental tape plus instruction in their use had less plaque and periodontal disease scores than did groups receiving these items and no instruction in their use, and than did controls receiving neither. All groups did have reduced plaque and periodontal scores, however (Elliott et al. 1972).

Little information is available from clinical trials completed with children in respect of gingivitis and periodontal disease; as these young age groups principally have been investigated for control of dental caries.

Lindhe and Koch (1966) studied the effect of supervised toothbrushing on gingival health and oral hygiene in school children aged 12 - 13 years of age which furnished evidence that strict hygiene measures can depress and even inhibit the progression of gingival disease with age in childhood. They also suggested (Lindhe, Koch, and Mansson 1966) that the effect of mouth rinsing as a prophylactic measure was most effective in the upper front teeth region and least effective in the lower molar region. In a later study, Koch, and Lindhe (1967) using sodium fluoride in dentifrices and as mouth rinses, suggested that sodium fluoride in the concentration 0.05% in a mouth rinse proved detrimental to the gingiva. As previously mentioned, Murray (1974), in a study of teenagers, concluded that fluoride in drinking water up to 2 ppm has no influence on the prevalence of gingivitis.

Williford, Johns, Muhler and Stookey (1967), in a study on oral health through education with a group of 14-18 year old students, indicated statistically significant oral hygiene improvements with associated improvement in the debris index and periodontal index used. Bratthall, Koch and Tynelius (1970), in a study comparing three methods of teaching oral hygiene to school children showed all methods caused a definite increase in learning. The study did not correlate this learning procedure with actual clinical oral hygiene.

Clinical trials, looking specifically at the gingival health of children are needed.

J) Scaling Frequency

There are only two studies on the required frequency of scaling. Both these studies were on young men. Those scaled four times a year in comparison to those scaled once a year over a four year period had only slightly less calculus, slightly less gingivitis, and slightly less loss of periodontal attachment (Lightner et al. 1971). In a comparison of scaling one, two or three times per year over three years, those scaled three times a year had less calculus, slightly less gingivitis, and no difference in sulcus depth or amount of attachment lost (Suomi et al. 1973). They concluded that once a year was sufficient.

k) Tissue Damage

The young men with the healthiest gingiva and lowest plaque scores, most frequently had gingival recession (O'Leary et al. 1969), and the prevalence and severity of recession increased with toothbrush instruction and regular scaling (O'Leary et al. 1971).

As previously mentioned, further controlled studies in children are required.

l) Chemical Agents

Chemical agents are at present being extensively investigated in respect to the reduction and prevention of plaque, calculus, and gingivitis. These include chlorhexidine (Loe 1973), ascoxal (Miller et al. 1962), quaternary ammonium compounds (Sturzenberger and Leonard 1969, Berswanger et al. 1974, de la Rose and Sturzenberger 1974, Ciancio et al. 1974, Comaton and Beagrie 1975), sodium ricinoleate (Schroeder et al. 1962), water soluble silicone (Draus et al. 1963), urea (Belting and Gordon 1966, Shapiro et al. 1973), vitamin C (Turesky et al. 1967, 1970), zinc salts (Picozzi et al. 1972, Fishman et al. 1973, 1974), alexidine (Lobene and Soparkar 1972, Barnes et al. 1972, Carlson and Porter 1973), and amine fluorides (Lobene and Soparkar 1974, de Palma et al. 1974).

Enzymes of many kinds have been tried (Shaver and Schiff 1970, Allen and Courtney 1972) including dextranases (Keyes et al. 1971, Lobene 1971, Caldwell et al. 1971, Nyman et al. 1972) and mucinases (Stewart 1952, Aleece and Forscher 1954, Leung and Draus 1959, Draus et al. 1963).

The antibiotics which are receiving the most attention are vancomycin (Mitchell and Holmes 1965, McFall et al. 1968, Kaslick et al. 1973), CC 10232 (Volpe et al. 1969, 1970, Stallard et al. 1969), kanamycin (Loesche et al. 1971) and erythromycin (Lobene et al. 1969).

All of these agents are as yet being used only experimentally in in vitro studies and in clinical trials.

Criteria have been proposed for antibiotics to be acceptable for use in the prevention of periodontal disease and caries (Mandel 1972). The antibiotic should not be one being used medically for serious diseases, and should not produce sensitization to other antibiotics that are so used; it should not produce resistant organisms or alter the general relationships of the normal flora; it should not produce sensitivity, allergy toxicity or irritation, or be significantly absorbed into the blood stream. It should be active locally at low dosage.

Chlorhexedine has been extensively investigated by Loe and his associates. They reported that it prevented the development of smooth surface caries (Loe et al. 1972), removed accumulations of plaque in animals (Lindhe 1970, Johnson and Kenney 1972, Hamp et al. 1973, Davies and Hull 1973) and in humans (Loe and Schiott 1970a, Gjermo et al. 1970), and prevented the formation of supragingival calculus (Schroeder 1969, Loe et al. 1971).

Gingivitis has been resolved in animals (Lindhe 1970, Johnson and Kenney 1972, Hamp et al. 1973, Davies and Hull 1973) and in humans (Loe et al. 1970a, Gjermo et al. 1970, Gjermo and Rolla 1970, 1971, Flotra 1973). For established gingivitis it was not as effective as scaling (Flotra 1973 et al. 1972).

Chlorhexedine binds to hydroxyapatite of enamel and is slowly released for up to 24 hours. It is active against gram positive and negative bacteria and yeasts. It has low local and systemic toxicity, but stains teeth, fillings, and the dorsum of the tongue; and has a bitter taste (Loe 1973). With prolonged administration some have had soreness and desquamation of the oral mucosa (Mandel 1972). At present chlorhexedine can not be used on patients in Canada and the U.S.A.

3. SMOKING

a) Periodontal Disease

Smokers have more severe periodontal disease than do non-smokers (Brandtzaeg and Jamison 1964, Waerhaug 1967, Solomon et al. 1968, Kristoffersen 1970, Sheiham 1971, Graves 1973, Loftus et al. 1974). Marginal gingivitis was not more severe in smokers according to Pindborg 1949, Ludwick and Massler 1952, Alexander 1970, Chang et al. 1973, Preber and Kant 1973; but it was more severe according to Herulf 1950, Forsberg 1954, Arno et al. 1958. Ninety-five to ninety-eight per cent of those with acute necrotic ulcerative gingivitis were smokers (Pindborg 1949, Ludwick and Massler 1952, Goldhaber and Giddon 1964). Gingival recession (Sheiham 1971, Graves 1973) and periodontal pockets (Sheiham 1971) were more prevalent in smokers. Pockets were deeper in the study of Loftus et al. 1974, but not in those studied by Forsberg 1954, Solomon et al. 1968, Chang et al. 1973; and loss of attachment was not greater in the smokers (Chang et al. 1973).

Tooth mobility and the number of mobile teeth were greater in smokers (Loftus et al. 1974). Alveolar bone loss was found to be greater in smokers (Herulf 1950, Arno et al. 1959, Herulf 1968, Graves 1973, Loftus et al. 1974) except in teenagers (Preber and Kant 1973). Tooth loss also was greater in smokers (Solomon et al. 1968) as was caries (Ludwick and Massler 1950).

b) Tooth Accumulations

Three studies reported slight to no difference in the amount of plaque (Alexander 1970) and debris (Kristoffersen 1970, Chang et al. 1973) in smokers and non-smokers. More debris was found in smokers by Brandtzaeg and Jamison (1964) and by Sheiham (1971), but the difference in calculus amount was greater (Sheiham 1971) than the difference in the amount of debris.

Smokers had more supragingival calculus (Pindborg 1949, Brandtzaeg and Jamison 1964, Alexander 1970, Sheiham 1971, Chang et al. 1973, Loftus et al. 1974) and subgingival calculus (Pindborg 1949, Alexander 1970) than did non-smokers.

Heavy smokers had more debris (Brandtzaeg and Jamison 1964, Kristoffersen 1970) and more severe periodontal disease (Brandtzaeg and Jamison 1964, Kristoffersen 1970) than did light smokers.

Although periodontal disease was not significantly more severe in smokers than in non-smokers when debris plus calculus scores were held constant, the relationship still is obscure. For it was calculus severity, including subgingival calculus, which varied more than debris severity; and if calculus is the result rather than cause of periodontal disease (Alexander 1969, Mandel 1960), the association of smoking to periodontal disease development is still not evident.

Because of the strong statistical relationship of cigarette smoking to lung cancer (Doll and Hill 1964), (U.S. Surgeon General 1972) there have been several studies aimed at reducing smoking and preventing the habit. Most have been unsuccessful.

4. SOCIOECONOMIC STATUS

The severity of periodontal disease is related to socioeconomic status. It is more severe in those of low socioeconomic level in Canada (Stamm 1971), United States (Russell 1957, Russell and Ayers 1960, Jamison 1960, Horton and Sumnicht 1967, 1968, Sheiham and Striffler 1970, Kelly and Van Kirk 1965), Norway (Brandtzaeg and Jamison 1964, Kristoffersen 1970), Sweden (Samuelson et al. 1971), Britain (Sheiham 1969, Beal and James 1970, Chiranjeevi and Wade 1972), India (Mehta et al. 1956, Waerhaug 1967), Australia (Lilienthal et al. 1965), and Nigeria (Enwonwu and Edozien 1970).

Debris is more prevalent and more consistently present in low socioeconomic boys (Anderson et al. 1974). Both debris and calculus increased in amount with decrease in socioeconomic level (Brandtzaeg and Jamison 1964, Lilienthal et al. 1965, Kelly et al. 1966, Horton and Sumnicht 1967, 1968, Sheiham 1969, Kristoffersen 1970, Enwonwu and Edozien 1970, Stamm 1971, Chiranjeevi and Wade 1972).

The relationship of periodontal disease severity to socioeconomic level still persists to some degree when the amounts of debris and calculus are held constant (Russell 1957, 1967). The difference between high and low levels of education is greater than between high and low levels of occupation (Anderson et al. 1974) and high and low levels of income (Russell 1957, Kelly and Van Kirk 1965).

5. DIET

The composition of the diet does not appear to be strongly related to the severity of periodontal disease in humans (Russell 1967). Fibrous or hard foods do not effectively remove plaque in humans (Carlsson and Egelberg 1965, Bergenholtz et al. 1967, Lindhe and Wicén 1969, Reece and Swallow 1970, Wade 1971, Suomi 1971, Bergenholtz 1972); but do influence the accumulation of debris and calculus in animals (Burwasser and Hill 1939, Stewart and Burnett 1960, Baer et al. 1961, Egelberg 1965, Keyes and Jordan 1965).

In studies with children, most investigations have again looked at caries control. Slack and Martin (1958) and Longhurst and Berman (1973) examined the effect of apples and gingival health in children. In the groups of children who eat apples after mid-day meals, the amount of plaque increased but for most children the gingival health improved. Slack, Duckworth, Scheer, Brandt and Ailianou (1972) investigated the effect of chewing gum on the incidence of dental diseases in Greek children. In a three year study they indicated no adverse effects on oral health and they suggested that regular chewing of gum may lead to a reduction in the incidence of gingivitis and calculus formation.

6. SYSTEMIC FACTORS

While local factors have been identified as the principal causes of periodontal disease, systemic influences affect the periodontal response to local irritants. But in the cases in which systemic etiology is suspected, it is usually difficult to establish what it is (Glickman 1972).

Stahl and associates have investigated the relationship of systemic diseases to periodontal disease (Stahl et al. 1952, Sandler and Stahl 1954 and concluded that the influence of generalized disease upon periodontal disease is not remarkable except for those with severe diabetes or liver cirrhosis (Sandler and Stahl 1960).

While many investigators have reported a relationship between periodontal destruction and diabetes (Sheppard 1936, Rudy and Cohen 1938, Lovestad and Austin 1943, Ziskin et al. 1944, Sheridan et al. 1959, Sandler and Stahl 1960, Williams and Mahan 1960, Belting et al. 1964, McMullen et al. 1967, Finestone and Boorujy 1967, Campbell 1967, 1972, Glavind et al. 1968, and Cohen et al. 1970), some did not (Rutledge 1940, MacKenzie and Millard 1963, Benveniste et al. 1967, and Hove and Stallard 1970).

Similarly, some reported that calculus was increased in diabetics (Rudy and Cohen 1938, Sheppard 1942, Amies and Park 1948, Sheridan et al. 1959), but others did not observe an increase (Mac Kenzie and Millard 1961, Benveniste et al 1967, Hove and Stallard 1970, Cohen et al. 1970, Campbell 1972).

Many case reports have been given concerning the relationship of systemic factors and medical conditions in children associated with gingival and periodontal tissue reactions.

Three recent chapters in text books have been published which review the more common conditions:-

1. Clinical Paedodontics: Finn: 4th Edition: W.B. Saunders Co. 1973.
2. Dentistry for the Child and Adolescent: McDonald: 2nd Edition: C.V. Mosby Co. 1974.
3. Periodontal Disease in Children and Adolescents: Baer: 1st Edition J.B. Lippincott Co. 1974.

7. TEETH

a) Impaction

Mandibular third molars which are completely covered and apically positioned, need not be extracted only because they are impacted. However, if there are indications that extraction may be necessary, all impacted and potentially impacted third molars in young patients should be extracted as early as possible to prevent the high incidence of loss of supporting structure and periodontal pocket formation that has been observed to occur on the distal of the second molars when third molar extractions were done in adults (Ash et al. 1962).

b) Position

Crowding and tipping of teeth enhance the accumulation and retention of debris and increase the difficulty in effective removal of plaque. Gingivitis was found to be greater where teeth were crowded (Massler 1958, McCombie et al. 1964, Trott et al. 1967, Sutcliffe 1968); and gingivitis was associated with crowding independently of the amount of debris (Sutcliffe 1968). Labially positioned teeth are susceptible to gingival recession. Hence, measures to promote and produce correct alignment of teeth help to prevent gingival inflammation and recession.

c) Shape

The shape of the teeth influence the accumulation of plaque and debris. Buccal bulges enhance gingival plaque accumulation, and broad interproximal contacts shelter plaque. On the other hand, loose contacts and flat buccal surfaces lead to impaction of food against the gingiva. Grooves extending through the cingulae of teeth promote food impaction and are a hazard to the periodontium (Everett and Kramer 1972).

d) Occlusion

A marked anterior overbite with no overjet frequently results in the impaction of food and/or teeth against the gingiva of the opposing teeth. Conversely, when there is no function on teeth, there is an increase in plaque, subgingival calculus and gingivitis (Alexander 1970).

Prophylactic occlusal adjustment is not accepted as a justifiable procedure (Glickman 1972).

Furthermore, there is no clear evidence what signs do justify occlusal adjustment to prevent destructive periodontal disease (Lovdal et al. 1959). Crowding and tipping of teeth enhance debris retention and gingivitis (Massler and Savara 1951, Ditto and Hall 1954, Sanjana et al. 1958, Suomi 1969, Biggar and Anderson 1974).

e) Restorations

Placement of margins of restorations subgingivally increases plaque retention and gingivitis (Wright 1963, Trott and Sherkat 1964, Hoover 1965, Loe 1968, Larato 1969, Bjorn et al. 1969, Rantanen 1970, Karlsen 1970, Silness 1970, Budtz-Jorgensen 1971, Mannerberg 1971, Renggli and Regolati 1972, Turgeon et al. 1972). Such gingivitis does not necessarily lead to destructive periodontal disease (Mannerberg 1971, Turgeon et al. 1972). Gingivitis is increased when margin of restorations are imperfect (Thomas 1949, Ramfjord 1952, Wright 1963, Alexander 1968, Bjorn et al. 1969, Sotres et al. 1969). Other investigators (App 1961, Hosoda et al. 1962, Suomi 1969) did not find inflammation of the gingiva contacting restorations.

Reduced caries and sequelae that was achieved with fluoridated water was thought to be the reason for less severe periodontal disease in spite of less toothbrushing and no less debris in those drinking the fluoridated water (Englander et al. 1963).

f) Replacement

For teeth adjacent to partial dentures, there was an increase in gingivitis, bone destruction and tooth mobility (Fenner et al. 1956, Carlsson et al. 1961, 1962, Seeman 1963). Thus, fixed prostheses are preferable to removable ones.

8. GINGIVA

a) Keratinization

Keratinization of the surface of the gingiva can be increased by massage with manual tooth brushes (Robinson and Kitchen 1948, Mehta et al. 1964, Stahl et al. 1953, Stanmeyer 1957, Merzel et al. 1963), power brushes (Toto 1966), and interdental stimulators (Cantor and Stahl 1965, Glickman et al. 1965).

The role of increased keratinization in improving periodontal tissues, or protecting them from irritants, especially products of micro-organisms, has not been determined. Thus, gingival massage cannot at present be considered a method of prevention.

b) Width

The width of the attached gingiva varies on different teeth (Bowers 1963, Ainamo and Loe 1966, Lang and Loe 1972). In recent years, surgical procedures have been promoted to increase the width of the attached gingiva in patients with gingival recession or periodontal disease. Some are now advocating graft procedures for preventive purposes in individuals with narrow width of attached gingiva, especially when the teeth are to receive full crowns or serve as abutments. There is no experimental evidence to indicate that any width of attached gingiva prevents periodontal disease, or that removal of all attached gingiva leads to serious consequences. Although lower cuspids have narrow width of attached gingiva and frequently exhibits gingival recession, these teeth are the least seriously involved by destructive periodontal disease (Fleming 1926, Miller and Seidler 1942, Bossert and Marks 1956, Schei et al. 1959, Wasserman et al. 1971), and are the last to be extracted because of periodontal disease (Bossert and Marks 1956). Some grafts increase the amount of keratinized gingiva rather than the amount of attached gingiva.

c) Frenae

Although mandibular frenae may become involved with gingival recession and sometimes pull on the gingival margin, which tends to lead to

inflammation and further recession; frenae rarely are initiating factors in recession of the gingiva. Thus, surgical removal of a high labial frenum in children to prevent future recession is not indicated. Many patients are capable of maintaining good oral hygiene even with a relatively high frenum attachment, shallow vestibule and minimum amounts of attached gingiva (Baer and Benjamin 1974).

SUMMARY AND CONCLUSION

The Present State of Preventive Periodontics

Recent reviews of preventive periodontics concluded that, at the present time, the evidence is inconclusive as to which procedures are best (O'Leary 1970, Suomi 1971, Glickman 1972, and Frandsen 1972). Therefore, the following opinions are based on studies and results which likely will be greatly modified in the future.

1. Plaque and Debris

- a) Plaque can evoke gingivitis.
- b) Plaque removal is dependent upon the individual's own personal care. Removal of plaque is most effectively accomplished by scrubbing with a medium hardness nylon bristle tooth brush and dentifrice, supplemented by the use of waxed or unwaxed dental floss or picks, depending upon the existing interdental space size. It is better to assess the gingival status than the amount of plaque, because it may not be necessary or possible to consistently remove all plaque; and the most effective method of plaque removal may be damaging to the gingiva and teeth.
- c) Tooth brushing and interdental cleaning tend to produce gingival recession and tooth abrasion.
- d) Methods and instruments matched to individual anatomical conditions and abilities are most likely to produce the best result. Manual brushing is as effective as power brushing, unless there is mental or physical disability.
- e) Although brushing once every two days is sufficient to avoid gingivitis, brushing twice daily was related to an improved periodontal status.
- f) Some chemicals, if used daily, can prevent plaque formation and may prevent gingivitis, but as yet none can be advocated for routine use by the public. Thus, at present, plaque removal must be by mechanical methods.

- g) Establishment of preventive procedures appears to be very much dependent on familial concerns and practices. Although young children should be receptive to developing a concern for the prevention of disease, most attempts to establish plaque removal habits have not been successful in elementary school children. In adults, plaque removal often can be improved only to a limited degree. Small group instruction, participation and interaction may improve learning and instill motivation to use preventive periodontal procedures.
- h) Gingivitis does not always result in the destruction of periodontal attachment tissue.

2. Calculus

- a) Calculus severity is related to the severity of periodontal disease. It is not clear which comes first.
- b) Removal of calculus improves gingival health beyond that attained with plaque removal by mechanical or chemical means, but is not sufficient alone.
- c) Removal of calculus is dependent upon the intervention of professionals.
- d) In young adults without periodontal disease, scaling once a year appears to be adequate. But, because individuals vary in rate of calculus formation, the frequency of scaling should subsequently be determined by the observed amount of calculus formed since the previous scaling.
- e) The amount of calculus and the severity of periodontal disease are related to the amount of smoking. The nature of the relationship is unknown. Prevention or elimination of smoking is difficult to achieve.

- f) Reduction in plaque sometimes, but not always, resulted in a reduction in calculus formation. It is not clear if a reduction in gingivitis or periodontal disease will result in a reduction in calculus formation.

3. Procedures Other Than Scaling

- a) Prevention of caries and the subsequent decrease in need for fixed and removable restorations appears to favour gingival health. If restorations are necessary, their margins should be placed incisal to the gingival margin.
- b) Obliteration of lingual grooves in maxillary lateral incisors, and re-establishment of tight proximal tooth contacts help prevent food impaction against the gingiva.
- c) Correction of marked overbite, tooth crowding and tipping and non-function, favour gingival health.
- d) Prophylactic occlusal adjustment and prophylactic surgical procedures to increase the width of attached gingiva are not justified at present.

RECOMMENDATIONS

a) Children

In the area of knowledge, in respect to the oral health of children, considerable further information is required.

Most studies to this time have been involved in caries control.

It is recommended that the following investigations are needed in the near future.

1. Sound epidemiological studies of gingival and periodontal health of children.
2. Recognition of internationally acceptable standards of diagnosis for gingival and periodontal indices.
3. Longitudinal studies, particularly through the mixed dentition period and puberty, until establishment of the permanent dentition; to establish changes in gingival and periodontal health.
4. Short term clinical trials in plaque dispersal, and the effects on gingival and periodontal health of children.
5. Studies in teaching and motivation to maintain excellent gingival and periodontal health.
6. Establishment of sound preventive programmes, not only for caries control, but for the maintenance of excellent gingival and periodontal health of children and adolescents.

b) Adults

Investigations are required to determine: -

1. An easy, efficient, inexpensive, safe means of supra and subgingival plaque prevention.
2. Whether the prevention of plaque will prevent the formation of supra and subgingival calculus.

3. If subgingival calculus is primarily a cause,
or a result of periodontal disease.
4. a) Why some teeth and some people are more resistant
to destructive periodontal disease.
b) Means of increasing the tolerance of the perio-
dontium to plaque.
5. The nature of the relationship of destructive
periodontal disease to: -
 - a) gingivitis
 - b) socioeconomic status
 - c) smoking

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